Land Characteristics of Batang Pelepat Watershed in Bungo District, Jambi

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ABSTRACT

Land Characteristics of Batang Pelepat Watershed In Bungo District, Jambi (Sunarti): Land characteristics describe biophysics characteristics of watershed. But, land has been used for economic oriented. The objective of this research is to identify land characteristics of Batang Pelepat watershed. Data collection was carried out by survey based on land unit map and analyzed by descriptive analysis. The results showed that land in Batang Pelepat watershed consist of 23 land units and some land use types (forest, rubber and oil palm farming, settlement and shrub), soil parent materials variously (alluvium, granite, tuff andesite, basalt, and clay rock), soil depth ranges from 88 to 160 cm and soil texture is classified moderate fine to fine. Lands were dominated by slope of >15–30% and >45–65% and dystrudepts of soil group with soil fertility level very low to low because its pH about 3.80-6.20, base saturation about 7.86-32.79% and P-available about 2.80-25.00 ppm. Various land use has also caused different erosion and permeability levels.

Keywords: Batang Pelepat, land characteristics, watershed

INTRODUCTION

Land is one of natural resources in watershed in addition to vegetation, water and enviromental service that are humans capital to fulfill their necessities of life. Land characteristics are one of factors that determines the characteristics of watershed. The increasing of population and development activities have caused land use practice for economic oriented. But area of land is relatively limited and constant. According to Kartodihardjo *et al*. (2004), generally land use in watershed is less concern to linkages of elements constituent of watershed systems, whereas carrying capasity conditions of watershed depend on complex and interrelated some factors. Those principles of land utilization have caused degradation of land and some watershed in Indonesia.

The conditions of land degradation in Indonesia have reached critical level. Area of land degraded in 1984 was 9.70 million ha and in 1994, it was increase up to 23.20 million ha; 15.20 million ha was located out of forest region and 8.10 million ha was located in forest region (Mas'ud *et al*. 2004). The same phenomenon have happened in Batang Pelepat watershed (upstream of Batanghari watershed). Land use in this region have reached steep slope and without considering rules of soil and water conservation (SWC). Utilization of land that doesn't match with it's carrying capasity will cause high erosion sensitivity, especially on bare land and in turn it will cause land degradation and increase area of critical land. It can be seen from predicted of erosion at some village in Batang Pelepat watershed; the erosion was more than tolerable of soil loss (TSL), such as in Baru Pelepat, erosion was reach 59.97 Mg $ha^{-1}year^{-1}$ and in Sungai Beringin, it was reach 55.00 Mg $ha^{-1}year^{-1}$; whereas TSL in both locations were only 16.92 and 15.98 Mg $ha^{-1}year^{-1}$ (PPLH UNJA, 2003).

Variables (characteristics) of land are criteria and indicators of watershed management and have large enough proportion (40%) to evaluation of watershed degradation level (BTPDAS Solo 2002; Mas'ud *et al*. 2004). Land characteristics of a watershed can also

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be used as consideration to choose technologies of watershed management or land use planning so that land can be used according to it's potential and sustainability of watershed can be maintained. However, availability of accurate soil properties (land characteristics) data are still not adequate. Therefore, the objective of this research to identify land characteristics of Batang Pelepat watershed.

MATERIALS AND METHODS

Location and Time of Research

The research was conducted at Batang Pelepat watershed in Bungo District, Jambi Province. Intensive observation of location was conducted on one of subwatershed in Batang Pelepat watershed; this area was 48,465 ha. The research had conducted for 3 months, from November 2006 till January 2007.

Materials and Tools

This research was need tools such as a set equipment of soil survey (soil bor, ring sampler, GPS, abney level, etc) and stationerry (pen, pencil, paper label, markers, notebook, etc). Whereas material required in this research included based maps (soil map, earth form map, and land use map) and chemical materials to analyze soil samples in laboratory.

Research Methodology

The method that used in this research was survey method. The survey was conducted based on land unit map. Land unit map was determined by overlaying soil, slope and land use maps. The data type in this research consist of primary and secondary data. The primary data include slope, land use, soil physical properties (texture and permeability) and some chemical properties such as pH, organic-C, available-P, base saturation, and cation exchange capacity of clay. The primary data including physical and chemical soil properties were collected by soil sample routine analysis in laboratory. The secondary data include maps and soil morphology data (landform and slope, erosion, soil depth, drainage, gravel/stone, flood, soil type, soil parent material, and land use).

Data Analysis

The data were analyzed by descriptive analysis to describe land characteristics of Batang Pelepat watershed.

RESULTS AND DISCUSSION

The results showed that land in Batang Pelepat watershed consist of 23 land units (Figure 1) which dominated by slope of >15-30% (13,354 ha or 27.55%) and slope of >45-65% (14,242 ha or 29.39%) (Table 1 and Figure 2). According to Harjadi *et al*. (2007), land characteristics of watershed is determined by topography factor of a region and slope dominantly, because watershed that dominated by steep slope and hill and mountain topography would be relatively sensitive to erosion and potentially to critical watershed.

The other land characteristics that describe watershed biophysic characteristics are landform, soil parent material, soil type, soil quality, and land use. Based on study from Balitbang Pertanian (2005), land in Batang Pelepat watershed had landform and soil parent material variously (alluvium, granite, tuff andesite, basalt, and clay rock). Therefore, land had also landform, soil type and fertility level variously. Land consist of 4 types (groups) of soil, *i.e*. *endoaquepts*, *hapludults*, *dystrudepts* and *kandiudox* (Figure 3). The result showed that dominan soil type in Batang Pelepat watershed were *dystrudepts* group, *i.e*. 35,441 ha or 73.13% (Table 1). Soil texture is classified sandy clay loam to clay (moderate fine to fine class). The various soil parent material and soil type also impacted on development of soil. According to result of this research also showed that land unit in Batang Pelepat watershed had soil depth about 88-160 cm (Tabel 2). The research data showed that land of watershed need variously management, especially to develope agricultural. The variously characteristics of land in Batang Pelepat watershed should be considered to plan land use so land can be used according to it's capability and suitability.

The utilization of land in Batang Pelepat watershed have changed from years to years. According to Diana (2000), the result of Biotrop research showed that land cover in Batang Pelepat watershed in 1984 was still dominated by forest (45,800 ha or 94.50% of watershed area) and there was no the other land use types, such as agricultural and settlement in this region. In 1996, area of forest coverage decreased up to 37,887 ha (78.17%) because there was land use for smallholder of rubber (2,857 ha or 5.90%) and settlement (95 ha or 0.20%). Furthermore, based on the research of Balitbang Pertanian (2005), actual land

Table 1. Slope, soil type, and land use area distribution of land units in Batang Pelepat Watershed.

Land Unit	Slope (%)	ɔrm	Parent Material	Land Use	Area (ha)	(%)
1	0-3	er floodplain	Aluvium	Monoculture of rubber	1,482	3.06
2	0-3	er floodplain	Aluvium	Monoculture of oil palm	147	0.30
3	>3-8	neplain	Clay rock	Monoculture of rubber	1,098	2.27
4	>3-8	neplain	Clay rock	Monoculture of oil palm	841	1.74
5	0-3	neplain	Clay rock	Monoculture of oil palm	248	0.51
6	>3-8	neplain	Clay rock	Rubber (Agroforestry)	6,026	12.56
7	>8-15	ıg Peneplain	Clay rock	Monoculture of rubber	70	0.02
8	>8-15	anic hills	Tuff Andesite	Monoculture of oil palm	60	0.08
9	>8-15	ıg Peneplain	Clay rock	Monoculture of oil palm	114	0.28
10	>8-15	anic hills	Tuf Andesit	Rubber (Agroforestry)	1,979	4.08
11	>15-30	anic hills	Granite	Monoculture of rubber	162	0.33
12	>15-30	anic hills	Granite	Monoculture of oil palm	144	0.30
13	>30-45	anic hills	Granite	Monoculture of rubber	84	0.17
14	>30-45	ıntain vulcanic	Tuff Andesite	Monoculture of rubber	61	0.06
15	>15-30	anic hills	Granite	Monoculture of oil palm	2,589	5.40
16	>3-8	anic hills	Granite	Monoculture of oil palm	79	0.16
17	>15-30	ıntain vulcanic	Tuff Andesite	Shrub	1,811	3.74
18	>30-45	anic hills	Granite	Shrub	249	0.51
19	>15-30	untain vulcanic	Tuff Andesit and basalt	Forest	8,648	17.84
20	>30-45	anic hills	Granite	Forest	5,738	11.84
21	>30-45	ıntain vulcanic	Tuff Andesite	Forest	2,548	5.26
22	>45-65	untain vulcanic	Tuff Andesit and basalt	Forest	14,242	29.39
23	0-3	er floodplain	Aluvium	Bare Land	45	0.09
	Total				48,465	100.00

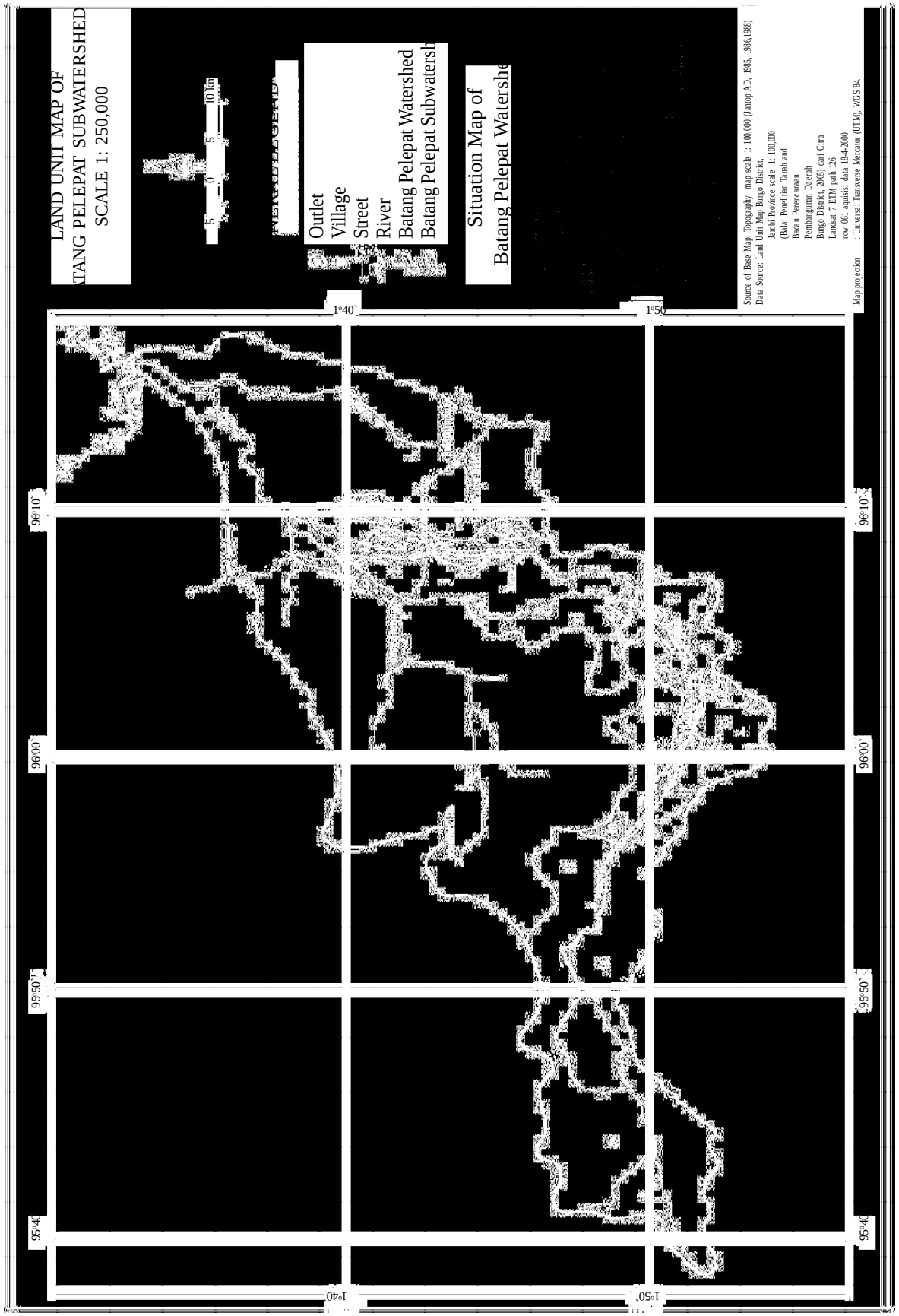

Figure 1. Distribution of land unit in Batang Pelepat Watershed.

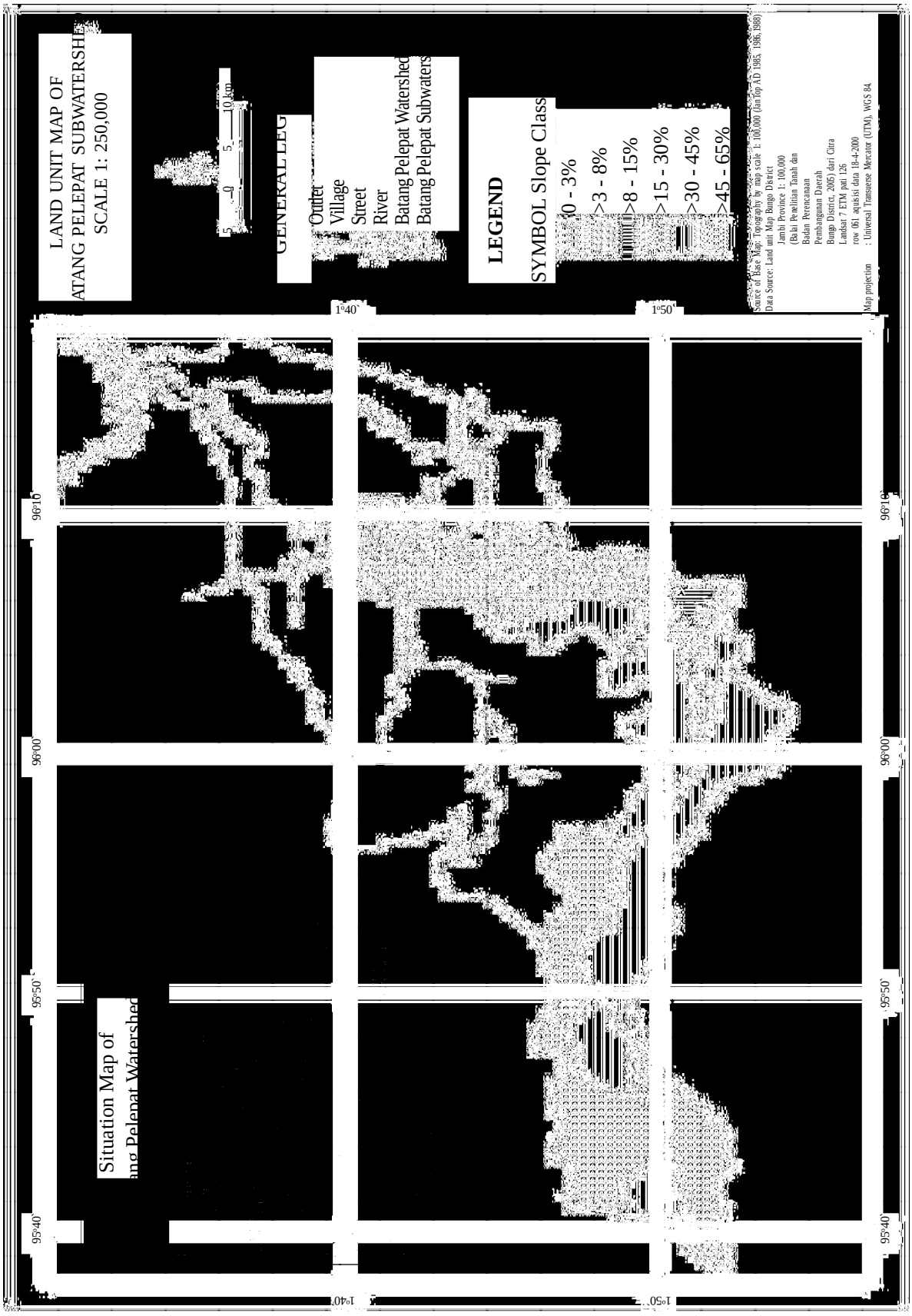

Figure 2. Distribution of Slope Class in Batang Pelepat Watershed.

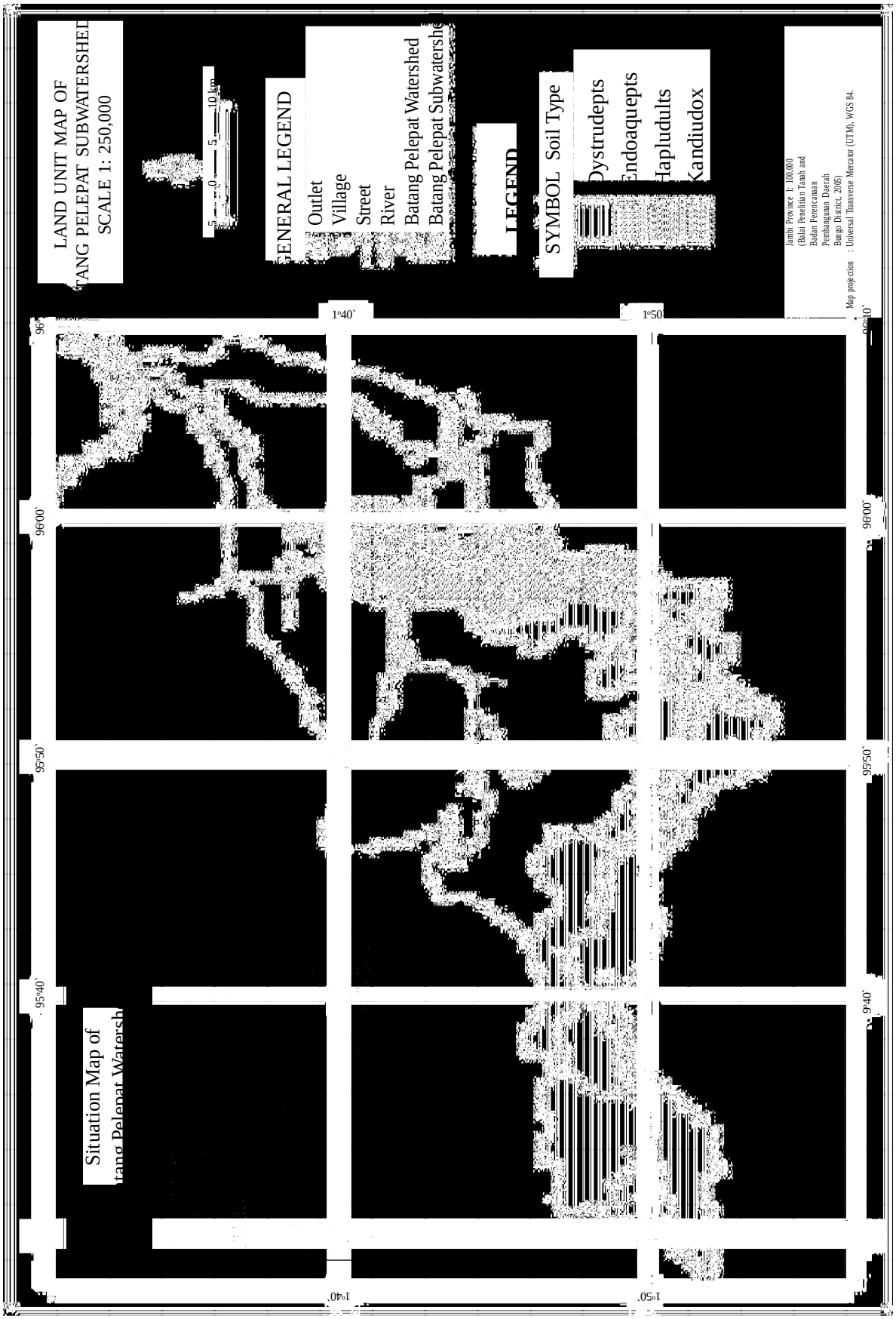

Figure 3. Distribution of soil type in Batang Pelepat Watershed.

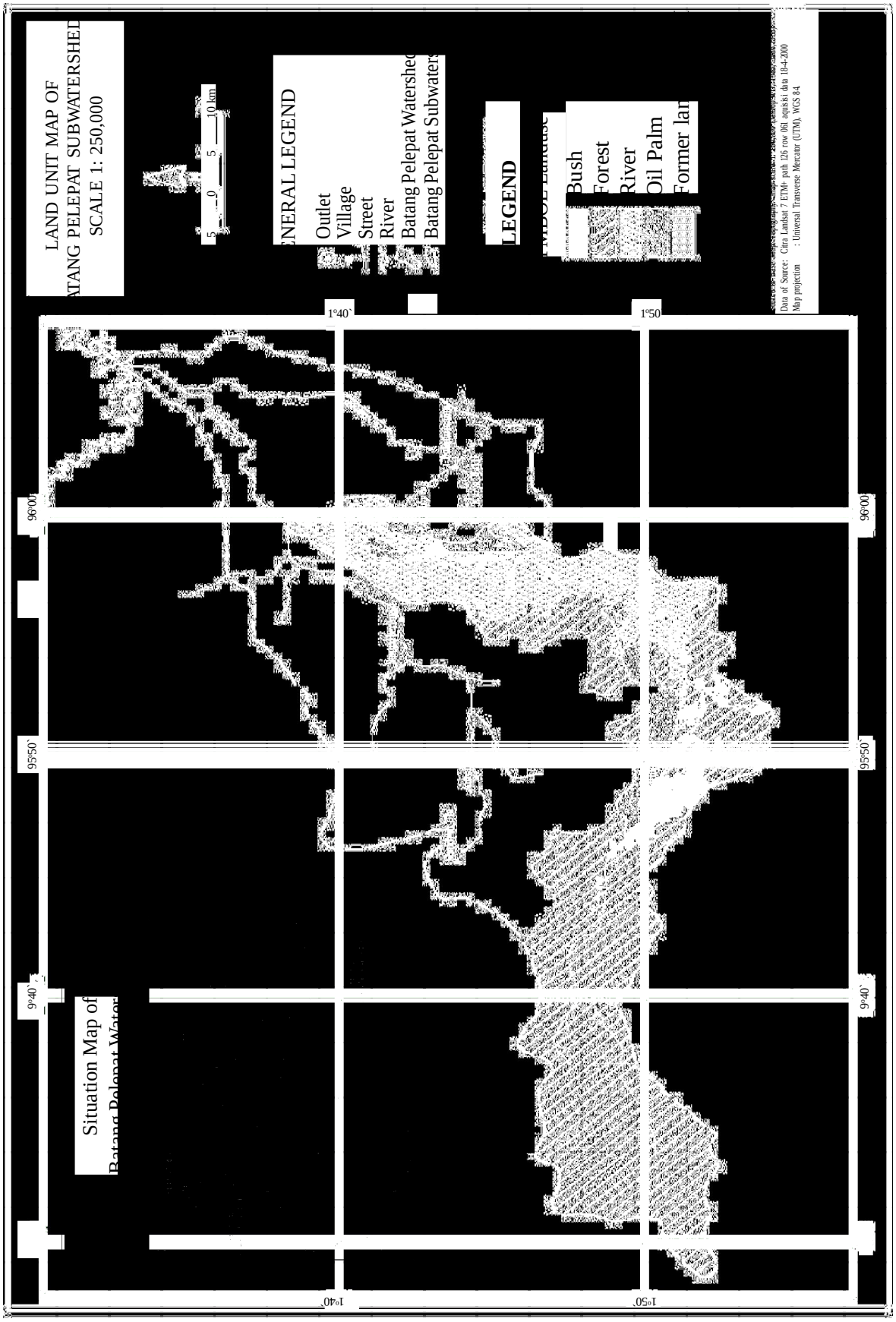

Figure 4. Distribution of landuse type in Batang Pelepat Watershed.

Table 2. Physical characteristics of land unit in Batang Pelepat Watershed according to field observation.

Land Unit	Slope (%)	Erosion	Soil Depth (cm)	Texture	Permeability	Drainage	Garvel/Stone	Food
1	2	no erosion	160	Silty clay loam	moderate	rather bad	no	sometimes
2	3	no erosion	160	Silty clay loam	moderate	rather bad	no	sometimes
3	6	light	140	Sandy clay	rather slowly	good	no	never
4	6.5	light	140	Sandy clay	rather slowly	good	no	never
5	8	light	140	Sandy clay	rather slowly	good	no	never
6	7	light	140	Sandy clay	rather slowly	good	no	Never
7	12	light	125	Clay loam	rather slowly	good	no	Never
8	15	moderate	150	Clay	moderate	good	no	Never
9	10	moderate	125	Clay loam	rather slowly	good	no	Never
10	14	light	150	Clay	rather slowly	good	no	Never
11	15	light	130	Clay	rather slowly	rather good	no	Never
12	20	moderate heavy	130	Clay	rather slowly	rather good	no	Never
13	35	moderate	88	Sandy clay loam	rather slowly	good	no	Never
14	45	light	120	Clay	rather slowly	good	no	Never
15	30	very heavy	88	Sandy clay loam	rather slowly	good	no	Never
16	5	moderate	88	Sandy clay loam	rather slowly	good	no	Never
17	25	moderate heavy	120	Clay	rather slowly	good	no	Never
18	30	moderate heavy	88	Sandy clay loam	rather slowly	good	no	Never
19	30	no erosion	140	Silty clay loam	moderate	good	no	Never
20	40	no erosion	88	Sandy clay loam	moderate	good	no	Never
21	40	no erosion	120	Clay	moderate	good	no	Never
22	55	no erosion	102	Clay	moderate	good	no	Never
23	2	no erosion	160	Silty clay loam	moderate	rather bad	no	Sometimes

use in Batang Pelepat watershed was classified in agricultural land use (generally rubber and oil palm farming) area of 15,184 ha or 31.33% and non-agricultural land use (forest, shrub and bare land) of 33,281 ha or 68.67% (Figure 4). The rubber and oil palm farming area was cultivated by farmer variously (Table 1). The various type of land use and land management in Batang Pelepat watershed would impact on land characteristics.

Based on the research of Sunarti *et al*. (2009) have known that each type of rubber and oil palm farming impacted on soil density level variously. Monoculture system of rubber have caused higher soil density than mixed planting system (polyculture system). In addition, each type of rubber and oil palm farming in Batang Pelepat watershed have also caused difference of erosion and run off level. Level of erosion and run off would also impact on level of land degradation or quality of the soil. This was also consistent with the result of the research of Wicaksono (2003). It was shown that the change of land use of pinus forest to the pasture have caused the change and difference on physical and chemical properties of soil (land quality) on every soil horizon.

Based on field observation, agricultural land use in Batang Pelepat for rubber and oil palm farming have reached slope of >30% and without SWC techniques, such as on land unit 13 and 14 (slope of >30-45%) and it was used as rubber farming land with monoculture system (Table 1). Permeability of agricultural land is generally classified moderate slow (Table 2) so that it will cause erosion and in turn it will also cause land degradation. Some land units have suffered moderate high erosion (land units 12, 17, and 18), indeed very high erosion (land units 15) (Table 2). Land units 12 and 15 were used for oil palm smallholder (2 year old plant) with monoculture system, whereas land units 17 and 18 are covered by shrub (Table 1).

Table 3. Status of some chemical properties soil in batang pelepat watershed according to criteria of Pusat Penelitian Tanah (1983).

Land Unit	pH		C-organic		P-Available		Cation Exchange Capacity of Clay		Base Saturation	
	Value	Status	Value	Status	Value	Status	Value	Status	Value	Status
1	5.00	acid	3.33	high	2.80	very low	26.20	high	30.37	low
2	5.00	acid	3.33	high	2.80	very low	26.10	high	30.37	low
3	4.50	acid	2.29	moderate	6.20	very low	24.09	moderate	11.41	very low
4	4.50	acid	2.29	moderate	6.20	very low	25.09	high	11.41	very low
5	4.50	acid	2.29	moderate	6.20	very low	26.09	high	11.41	very low
6	4.50	acid	2.29	moderate	6.20	very low	27.09	high	11.41	very low
7	5.30	acid	2.66	moderate	16.60	moderate	27.70	high	10.91	low
8	5.20	acid	3.20	high	5.40	very low	18.78	moderate	25.98	low
9	5.30	acid	2.66	moderate	16.60	moderate	27.70	high	10.91	low
10	5.20	acid	3.20	high	5.40	very low	18.78	moderate	25.98	low
11	3.80	Very acid	1.89	low	6.10	very low	16.42	low	12.80	very low
12	3.80	Very acid	1.89	low	6.10	very low	16.42	low	12.80	very low
13	4.20	Very acid	1.90	low	7.90	very low	33.04	high	32.79	low
14	6.20	moderat acid	2.96	moderate	6.70	very low	21.80	moderate	24.53	low
15	4.20	Very acid	1.90	low	7.90	very low	33.04	high	32.79	low
16	4.20	Very acid	1.90	low	7.90	very low	33.04	high	32.79	low
17	6.20	moderat acid	2.96	moderate	6.70	very low	21.08	moderate	24.53	low
18	4.20	Very acid	1.90	low	7.90	very low	33.04	high	32.79	low
19	4.80	acid	4.62	high	25.00	moderate	35.20	high	7.86	very low
20	4.20	Very acid	1.90	low	7.90	very low	33.04	high	32.79	low
21	6.20	moderat acid	2.96	moderate	6.70	very low	21.80	moderate	24.53	low
22	5.20	acid	7.33	very high	10.50	low	36.80	high	28.03	low
23	5.10	acid	3.33	high	2.80	very low	26.20	high	30.37	low

Characteristics of every land unit showed that generally soil in Batang Pelepat watershed have very low to low fertility level. Level of acidity of soil is clasiffied very acid to acid (pH 3.80-6.20). It had very low to low base saturation level (7.86-32.79%). It would impact on plant nutrients availabilty such as P-available is only about 2.80-25.00 ppm. The high level of soil organic matter contents was found on land unit with very close coverage and dense of litter, *i.e.* forest coverage (Table 3). The result of research showed that also land characteristics with forest coverage is different from land characteristics with the others coverage, such as agricultural, shrub and bare land.

The very low to low fertility level of Batang Pelepat watershed land have effected on low productivity of rubber and oil palm. According to data from Disbun Provinsi Jambi (2005), rubber and oil palm productivity in Batang Pelepat watershed are only 0.45 Mg ha^{-1} and 11 Mg ha^{-1} TBS, respectively. Therefore, development of rubber and oil palm farming systems in Batang Pelepat watershed should be followed by the adequate application of technology. According to Sunarti (2009), rubber farming in Batang Pelepat watershed could be developed by application of various technology alternatives. One of cultivated technology that can be applied is technology recommendation from Balai Penelitian Perkebunan Sembawa (2003), *i.e.* application of techniques SWC and fertilizer include Urea (250-350 g^{-1} $tree^{-1}$ $year^{-1}$), SP-36 (125-260 g^{-1} $tree^{-1}$ $year^{-1}$) and KCl (100-300 g^{-1} $tree^{-1}$ $year^{-1}$).

Planning of farming to choose appropriate technology must based on land characteristics. Therefore, land characteristics in Batang Pelepat watershed must be a primary consideration for utilization of land in this region, especially for agricultural in development because this region is priority region for rubber and oil palm development Bungo district (BAPPEDA Bungo, 2005). Based on land characteristics data can be evaluated and determined level or class of land capability and suitability for agricultural so that land can be used

based on its potential. According to Sinukaban (2007), the land capability and suitability analysis are the first step of design planning for sustainable agricultural development.

CONCLUSIONS

Land in Batang Pelepat watershed (area about 48,465 ha) consisted of 23 land units, have variously landform and dominated by *Dystrudepts* soil type. Soil have parent material variously (alluvium, granite, tuff andesite, tuff andesite basalt, and clay rock), soil depth range is 88-160 cm and texture is classified as moderate fine to fine. The land use type consist of forest, shrub, settlement and agricultural. Agricultural land in Batang Pelepat watershed is generally used as rubber and oil palm farming land. Land have very low to low level of fertility with some indicators (pH is about 3.80-6.20, base saturation is about 7.86-32.70%, P-available is about 2.80-25.00 ppm). The variously land use have caused difference of erosion and permeability level of land in Batang Pelepat watershed. Therefore, the utilization of land as agricultural land use must be followed with fertilizing recomendation and SWC techniques. The characteristics of every land unit can be used to design accurate technology to agricultural development in Batang Pelepat watershed.

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